- **Variant on OCEA'92 Award employed on the SE 17th Street Bridge Concept by the same Engineer using Segmental Concrete Swing Span**
- **Concept maintained waterborne and roadway traffic on existing horizontal alignment without costly, temporary, moveable bridge and approaches**

SPANS

Hillsborough County Florida

Public Works Department
Bridge Team

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DOUBLE OR NOTHING

Florida is America's playground and when you visit Fort Lauderdale this is immediately apparent when driving east on the Southeast, 17th Street Bridge spanning the Inter-coastal Waterway (ICWW). Driving east, toward the Atlantic Ocean, you see: a wall of hotels marching single file for miles along the ocean beaches moving from left to right and reaching to the ocean inlet, southeast of the bridge; the giant cruse ships moored to the bulkheads along the ICWW and the swarm of private yachts coming and going to the vast array of canals and docks servicing waterfront homes to the north (Figure 1). These recreational boats include sailboats with masts 60' tall and on special occasions they will bring in the majestic, Tall Ships with their 100' masts passing north through the bridge (Figure 2).

FIGURE 1 : View north including abandoned concept

The residents had a great deal of pride in there community and liked to refer to Fort Lauderdale as the Venice of America. Whenever a government agency recognizes that one of it's bridges becomes structurally deficient and/or functionally obsolete they will often times plan for its replacement with a wide range of variables taken into consideration. Early in the 1980's, the Florida Department of Transportation (FDOT), District 4 encountered such a set of circumstances regarding the two lane, double leaf bascule on the over taxed, Southeast 17th Street Bridge in Fort Lauderdale, Florida. The FDOT hired the consultant, Parsons Brinkerhoff Quade & Douglas (PBQD), and was pursuing a replacement plan with the design for a tunnel.

The tunnel design was in the hands of one of the premier tunnel experts in the country with PBQD and the early design depicted a solution with an overall length of 2640', having a total of 1450' of boat section approaches, all having a top of wall elevation of 10'-0" above mean low sea level. The twin, 45'-4½", outside diameter, steel lined tubes ducted under the Stranahan River (ICWW) allowing a minimum 14' of water depth over the tunnel. The estimated $82 million tunnel design did not survive the nearly 10 years of public scrutiny played out in the press.

FIGURE 2 : View of concept with swing span open

David Kidwell, of the *Miami Herald*, on December 15, 1994

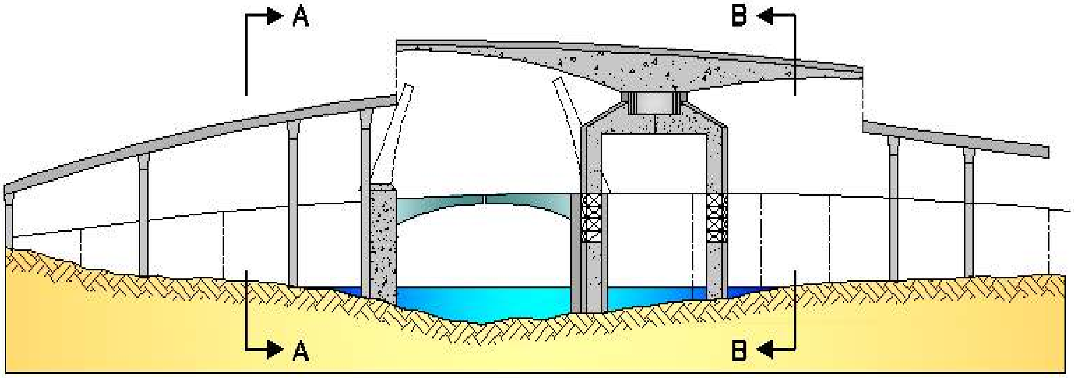


FIGURE 3: North elevation of concept construction sequence

reported "Weary from a decade of ill-fated attempts to replace Fort Lauderdale's busiest ICWW drawbridge, state road builders on Wednesday handed over the design decisions to the local residents they've spent years fighting." Kathleen Kernicky of *The Fort Lauderdale Sun-Sentinel* with her article of December 16, 1994 describes: "Simple, sleek and elegant is what Fort Lauderdale residents want the new Southeast 17th Street drawbridge to look like when it opens over the Intracoastal Waterway in five years".

And, she quotes Mae Simmons, the Harbor Beach Realtor who lead the causeway fight for a new drawbridge instead of a state-favored tunnel, "We didn't want the standard DOT Bridge with a pineapple or a fish hanging down the side." A bridge with a view (Figure1) remains one of the resident's biggest concerns. "We have the water, the palm trees, the cruise ships. We want to show off Fort Lauderdale," Simmons said.

David Kidwell continues in the *Herald's* August 24, 1995 issue with, "the new four-lane bridge will be 55 feet high, held up by curved, V-shaped pillars adorned on both ends with millions of dollars worth of palm trees and bushes, and lined with such amenities as a scenic overlook and bike paths." Kidwell points out that, "after the tunnel went down the tubes, next came the plan for an enormous, 85-foot-high arching bridge (by PBQ&D) that would eliminate the need for a drawbridge. Simmonds' group said no to that one, too. It found the arch too imposing."

PBQ&D had another proposal for their client that was based on a bridge they were involved with in Seattle, Washington that won the American Society of Civil Engineers, Outstanding Civil Engineering Achievement Award for 1992. Despite its' sleek, form-follows-function design and no need for a costly, temporary bridge it was decided not to submit for consideration due to the long history of development for the Southeast, 17th Street, Moveable Bridge Replacement Project. However, with the perspective of two decades of operation in Seattle, it might be worth adding to the inventory of bridge knowledge and experience for the good of the profession with the following description.

The existing right-of-way (ROW) is 200' wide and the then existing bridge width of 52' had a horizontal alignment centered on the 200' ROW. The proposed horizontal alignment for the new, 102' wide structure was also centered on the existing, 200' ROW. The proposed vertical alignment was raised 20' which provided a minimum vertical clearance of 65' over the channel for this alternate. This concept called for maintaining existing roadway and waterborne traffic throughout the construction period, without the need of a temporary bridge.

All of the new bridge piers were to be constructed within the existing ROW but outboard of the existing bridge footprint (Figure 3, Section A). The approach piers would have a Tee beam configuration that would support the longitudinal beams and slabs for the twin, 25' wide approach, roadway structures (Figure 4, Section A, Phase I). Next, the four columns to support the pivot point of the channel, swing span would be constructed, also in the zones between the original 52' wide footprint and the two, new, 25' zones on either side of the centerline west of the main channel .The centerlines for these four piers form a 45 degree angle with the bridge's longitudinal axis and their rectangular cross sectional areas were oriented in plan with the letter "X" configuration (Figure 7).

These four columns were capped by two transfer girders that had their soffits at a constant elevation but their depths increased across their tops as they approached their point of intersection

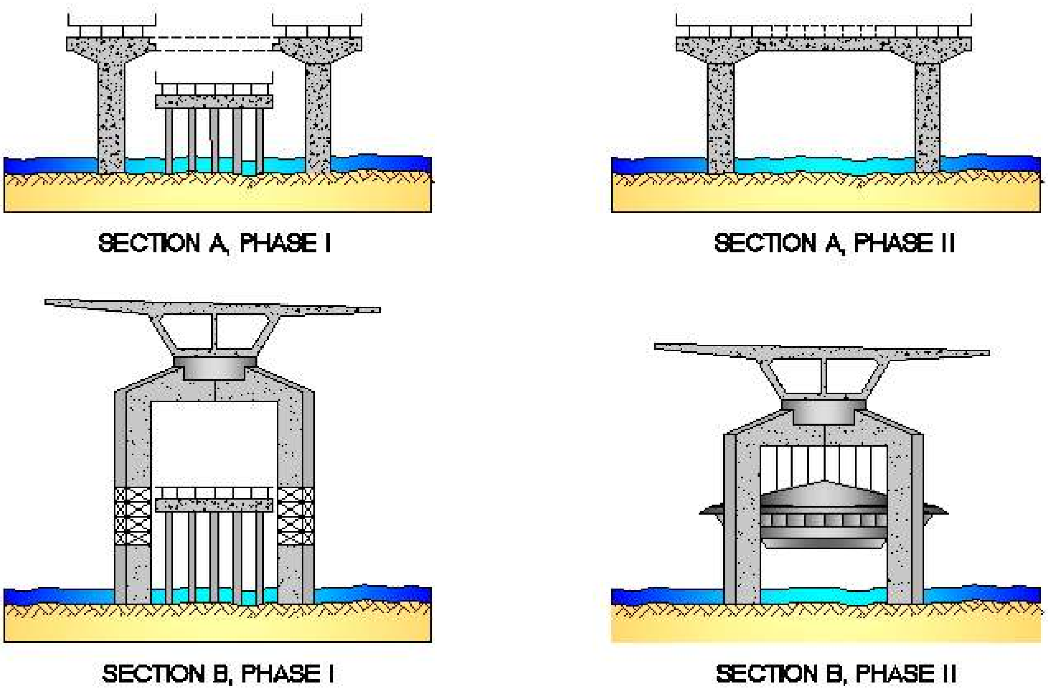


FIGURE 4: Concept's construction sequence; Section A for fixed spans and Section B for the moveable span.

FIGURE 5: Water level, south elevation, of concept

FIGURE 6: Water level, south elevation, of existing bridge

under the center pivot for the superstructure (Figure 3, Section B). The final, bottom elevation of these intersecting girders, during construction, would not allow adequate vertical clearance for the existing bridge's on-going roadway traffic so the transfer girders and superstructure are positioned, temporarily, 20' higher than their intended, final location by steel cages (Figure 4, Section B, Phase I). The superstructure would be a full 102' wide, cast-in-place, variable depth, segmental concrete box-girder that would be constructed in the open position, parallel to the fully operational navigation channel.

Once the operation of the superstructure, swing-span has been fully tested it would be lowered by hydraulic jacks, with the sequential removal of the steel cages, into its' final profile grade line (PGL). With this configuration, vehicular traffic is now diverted to the new structure single lanes up and down the new, 25' wide, outboard roadway structures and across the full 102 foot wide moveable section (Figure 4, Section B, and Phase II). At this interim stage the contractor will be working off the original bridge structure progressing his way out from the new, 102' wide, moveable section by installing the transverse, pre-cast, drop-in beams then the casting of the decks. Once the 102' wide approaches are completed and match the width of the moveable section's 102' width the full 4-lane structure can be opened to traffic (Figure 4, Section B, Phase II).

The 1991 operational, 480' main span, West Seattle Freeway, double swing span, segmental concrete, box girder bridge served as the prototype for this 17th Street Bridge concept. PBQ&D was a member of this design team and the MBE, structural, sub-consultant, Contech Consultants, Inc., was the segmental concrete box girder designer for this precedent setting structure. PBQ&D found themselves facing the dilemma of presenting another alternate, only the second of its type in the world, for this hotly contested contract or not to submit. The choice was made not to submit.

Nevertheless, the possibilities are intriguing: would this design have provided the sleek, clean, timeless, no gingerbread, signature solution the residents were seeking? Another afterthought would have been to take advantage of the wide stance of the intersecting girders and add a restaurant, with a multi-million dollar view, by suspending it from these girders (Figure 7). With the enormous advances in computer technology over the past twenty years Kirk Olsson is able to delineate an accurate picture to compare the "what if" scene (Figure 5) to the actual bridge from the exact same point of view (Figure 6).

Kidwell's article continues quoting Mae Simmons with, "Now, not only do we have a bridge," she said, "we have a beautiful signature bridge. What do I say to people who tell me you can't fight city hall? I found out differently." The Design team responsible for the existing bridge was composed of E.C. Driver (as prime) for the moveable spans and Figg Engineering Group (as sub) for the fixed spans.

FIGURE 7: North elevation of concept's open, swings-pan, pivot-point with suspended restaurant

Hillsborough County
Florida

Guest Commentary

By: Scott Arnold

Roebling Suspends Canal

I had the opportunity to see and learn a bit about a historic bridge on a recent trip to the New England area. We left Hancock, New York on the morning of July 8 on my motorcycle, heading south along the Delaware River on SR 97. The road is hilly and winding with beautiful views of the river for miles. Rounding a curve, we saw a timber bridge on stone piers crossing the river ahead of us. A National Park Service sign stated that it was the Delaware Aqueduct, also now known as the Roebling Bridge.

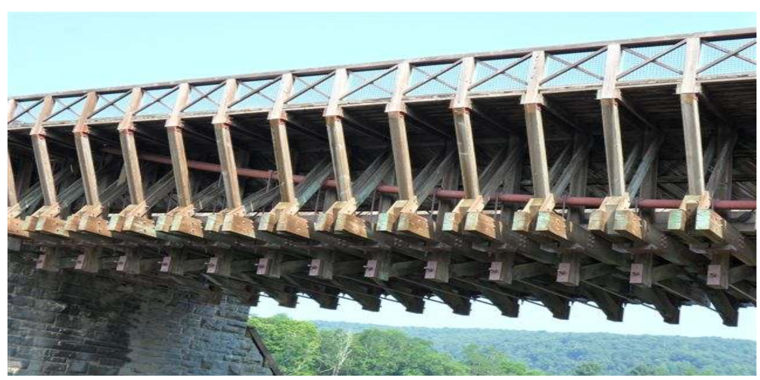
The bridge was one of four suspension aqueducts designed by John A. Roebling in 1847, for the Delaware and Hudson Canal. The D&H Canal connected the coalfields of northeastern Pennsylvania with markets along the Hudson River, and was operated from 1828 to 1898. A rope ferry was initially used to cross the Delaware River from Minisink Ford, New York to Lackawaxen, Pennsylvania, until the decision was made to elevate the canal above the river to decrease travel time on the canal and avoid collisions with traffic on the river.

The 535 feet long bridge was originally designed with one span at 142'-0" and three spans at 131'-0", with the longer span on the Pennsylvania side. The canal was conveyed across the bridge in a wood trunk or flume, approximately 6 feet deep and 19 feet wide at the waterline. An 8 feet wide towpath was located on each side of the trunk. The sides and bottom of the trunk were constructed of two layers of 2 ½" thick pine planks, caulked for water-tightness. The trunk was supported by transverse 6" x 16" double floor beams at 4'-0" spacing. The floor beams were hung from 1 ¼" diameter wrought-iron suspension rods. The suspension rods are shaped like inverted U-bolts, and bear on the suspension cables on cast iron saddles.

Roebling developed the method to fabricate the suspension cables and anchor the ends at the Pittsburgh Aqueduct. Each suspension cable was 8 ½" diameter and was composed of seven strands. Each strand consisted of 270 to 325 wires. The 2,150 wires were individually spun in place to form the cables and the weight per foot (excluding the continuous wire wrapping) was 122.74 pounds. The total length of each cable was 576 feet. The cables were supported on saddles at the piers and connected to anchor bars at the ends. The anchor bars extended down through the anchorage masonry and terminated in 6 feet square cast iron anchor plates. Roebling calculated the ultimate strength of the pair of cables to be 3870 tons, with an applied load of 770 tons.

The aqueduct was converted into a private toll bridge when the canal closed in 1898 and no longer contained any water. A toll house was built on the New York side by Charles Spruks in 1900. In the following years, the towpaths and sides of the trunk were removed. The wood icebreakers at the piers were not maintained and were finally destroyed. Sections of the canal, including the bridge, were designated a National Historic Landmark in 1968. The aqueduct continued to serve as a vehicular bridge until 1979, and was purchased by the National Park Service in 1980 to be preserved as part of the Upper Delaware Scenic and Recreational River. The bridge was also designated a National Civil Engineering Landmark.

The suspension cables and almost all of the saddles and suspension rods are original components. The wire wrapping on the suspension cables was replaced in 1985 as part of an NPS restoration project. The wood superstructure was reconstructed in 1986 using Roebling's original plans. The wood icebreakers, towpaths and aqueduct walls were reconstructed in 1995. The transverse timber floor beams now support precast concrete slab units with cast-in-place concrete topping, which accommodates a single lane of vehicular traffic.



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